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Washoe Lake
Washoe County
Nevada

National Eutrophication Survey, Las Vegas, Nev

Prepared for

Environmental Monitoring and Support Lab, Las Vegas, Nev

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16. ABSTRACT

Annual total phosphorus and total nitrogen loadings to the lake were estimated and subdivided according to either point or non-point source origin. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Eutrophication Survey during the one year study of the lake and its tributaries are included in the report.

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U.S. ENVIRONMENTAL PROTECTION AGENCY
NATIONAL EUTROPHICATION SURVEY

WORKING PAPER SERIES

REPORT

ON

WASHOE LAKE

WASHOE COUNTY

NEVADA

EPA REGION IX

WORKING PAPER No. 814

CORVALLIS ENVIRONMENTAL RESEARCH LABORATORY - CORVALLIS, OREGON

and

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REPORT ON WASHOE LAKE

WASHOE COUNTY, NEVADA

EPA REGION IX

by

National Eutrophication Survey

Water and Land Quality Branch
Monitoring Operations Division
Environmental Monitoring & Support Laboratory
Las Vegas, Nevada

and

Special Studies Branch
Corvallis Environmental Research Laboratory
Corvallis, Oregon

Working Paper No. 814

OFFICE OF RESEARCH AND DEVELOPMENT
U.S. ENVIRONMENTAL PROTECTION AGENCY

September 1977

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FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to freshwater lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point source discharge reduction and nonpoint source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's freshwater lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by the U.S. Environmental Protection Agency and to augment plans implementation by the States.

ACKNOWLEDGMENTS

The staff of the National Eutrophication Survey (Office of Research and Development, U.S. Environmental Protection Agency) expresses sincere appreciation to the Nevada State Environmental Protection Service for professional involvement, to the Nevada National Guard for conducting the tributary sampling phase of the Survey, and to those Nevada wastewater treatment plant operators who provided effluent samples and flow data.

The staff of the Department of Conservation and Natural Resources, Division of Environmental Protection, State Environmental Protection Service provided invaluable lake documentation and counsel during the Survey, reviewed the preliminary reports and provided critiques most useful in the preparation of this Working Paper Series.

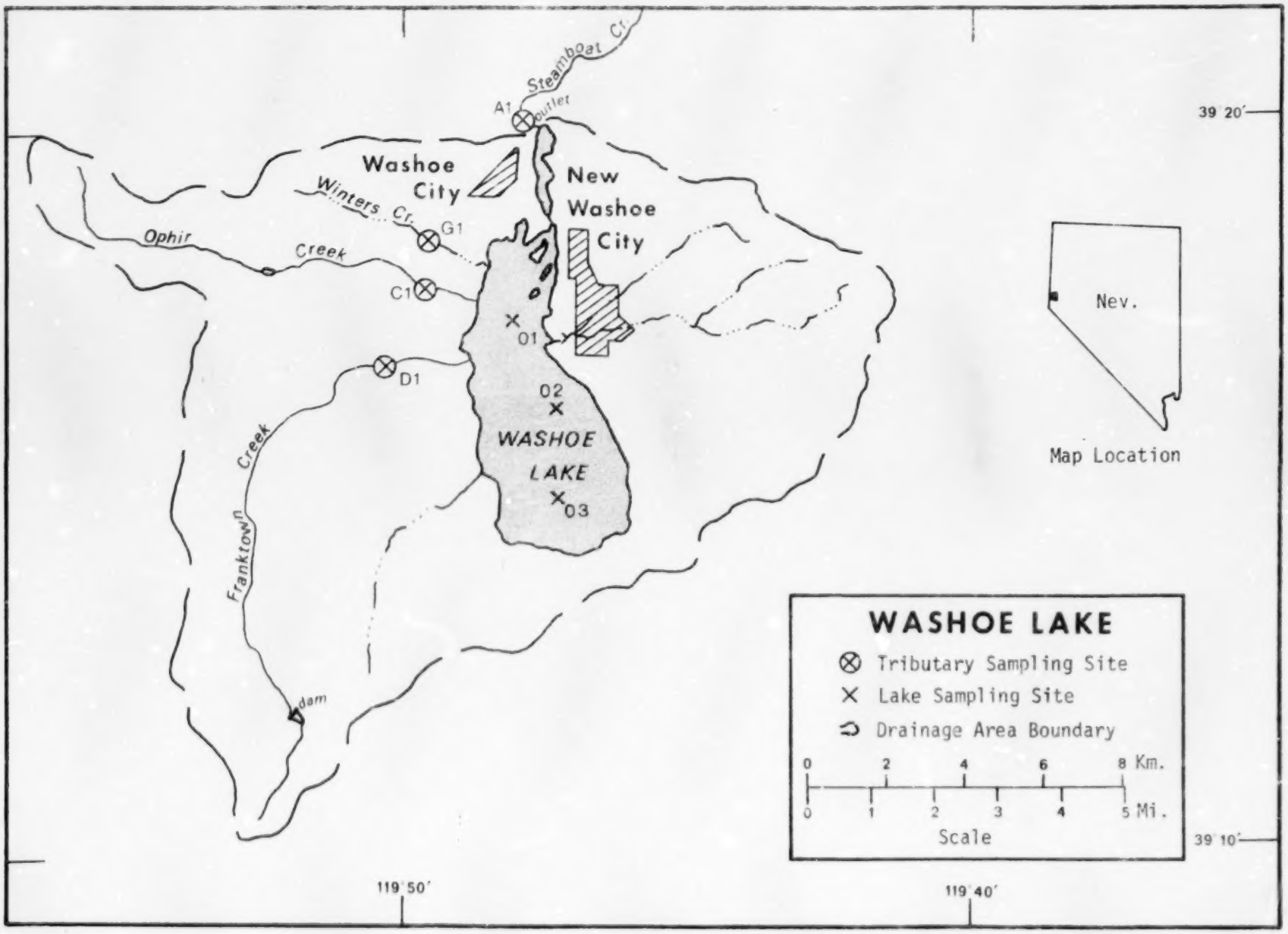
Major General Floyd L. Edsall, the Adjutant General of Nevada, and Project Officer Major Harold E. Roberts, who directed the volunteer efforts of the Nevada National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

NATIONAL EUTROPHICATION SURVEY

STUDY LAKES

STATE OF NEVADA

LAKE NAME	COUNTY
Lake Mead	Clark (Mohave in Arizona)
Lahontan Reservoir	Lyon, Churchill
Rye Patch Reservoir	Pershing
Lake Tahoe	Washoe, Carson City, Douglas (Placer, El Dorado in CA)
Topaz Reservoir	Douglas (Mono in CA)
Upper Pahranagat Lake	Lincoln
Washoe Lake	Washoe
Wildhorse Reservoir	Elko
Wilson Reservoir	Elko
Walker Lake	Mineral


Steamboat Cr.
A1
Outlet
39 20′
Washoe City
New Washoe City
Winters Cr.
G1
Ophir
Creek
C1
01
D1
02
WASHOE LAKE
03
Franktown Creek
dam
Nev.
Map Location
WASHOE LAKE
Tributary Sampling Site
Lake Sampling Site
Drainage Area Boundary
0 2 4 6 8 Km.
0 1 2 3 4 5 Mi.
Scale
39 10′
119 50′
119 40′

REPORT ON WASHOE LAKE, NEVADA

STORET NO. 3208

I. CONCLUSIONS

A. Trophic Condition:*

Survey data indicate that Washoe Lake is eutrophic, i.e., nutrient rich and highly productive. Whether such nutrient enrichment is to be considered beneficial or deleterious is determined by its actual or potential impact upon designated beneficial water uses of the lake.

Chlorophyll a values in the lake ranged from 4.7 µg/l to 20.7 µg/l with a mean of 11.6 µg/l. Potential for primary productivity as measured by algal assay control yields was high in March and moderate in November. Of the 10 Nevada lakes sampled in 1975, only 1 had higher median total phosphorus values (0.403 mg/l), 4 had higher median inorganic nitrogen levels (0.130 mg/l), and 1 had higher median orthophosphorus values (0.268 mg/l) than Washoe Lake.

Survey limnologists did not report any algal blooms or macrophyte problems on their visits to the lake. However, extremely low Secchi disc visibility (range of 0.08 - 0.25 m) suggest that primary production in Washoe Lake is light- rather than nutrient-limited.

*See Appendix E.

B. Rate-Limiting Nutrient:

Algal assay results indicate nitrogen was the primary limiting nutrient in Washoe Lake during the March sampling time (03/17/75). Lake data further suggest nitrogen limitation in the lake throughout the sampling year.

C. Nutrient Controllability:

1. Point Sources -

There were no known point sources impacting Washoe Lake during the sampling year.

Substantial nutrient contributions to the lake attributable to septic tanks may exist. The Nevada Environmental Protection Service (F. Luchetti, Personal communication) reports there are approximately 3,000 people living in the vicinity of the lake, all of whom are connected to septic tanks. However, it is not known how many of these septic tanks are within 100 meters (U.S. EPA, 1975) of the shoreline, or if those outside this 100 meter limit do indeed contribute nutrients to the lake as has been suggested (F. Luchetti, Personal communication). Additional study is recommended to obtain a more accurate picture of the nutrient budget for Washoe Lake.

The present phosphorus loading of 0.10 g $P/m^2/yr$ is equal to that proposed by Vollenweider (1975) as "eutrophic" for a lake with such volume and hydraulic retention time. Although

Vollenweider's model may not be applicable to highly turbid water bodies, Washoe Lake obviously is highly eutrophic and phosphorus levels in the waterbody will have to be substantially reduced before water quality improvement can be expected.

2. Nonpoint sources -

During the sampling year Franktown Creek contributed 19.3% of the total phosphorus load to Washoe Lake, Ophir Creek contributed 7.5% and ungaged tributaries were estimated to have contributed 55.3% of the total.

The phosphorus exports of the three gaged tributaries to Washoe Lake (See Section IV-D) were substantially lower than the phosphorus export of the Carson River to nearby Lahontan Reservoir*.

*See Working Paper 807, "Report on Lahontan Reservoir".

II. LAKE AND DRAINAGE BASIN CHARACTERISTICS

Lake and drainage basin characteristics are itemized below. Lake morphometry data were provided by James B. Williams, Jr. (personal communication). Tributary flow data were provided by the Nevada District Office of the U.S. Geological Survey (USGS). Outlet drainage area includes the lake surface area. Mean hydraulic retention time was obtained by dividing the lake volume by mean flow of the outlet. Precipitation values are estimated by methods as outlined in National Eutrophication Survey (NES) Working Paper No. 175. A table of metric/English conversions is included as Appendix A.

A. Lake Morphometry:

1. Surface area: 16.59 km^2.
2. Mean depth: 1.5 meters.
3. Maximum depth: 3.6 meters.
4. Volume: 25.163 x 10^6 m^3.
5. Mean hydraulic retention time: 2,080 days (5.7 yrs).

B. Tributary and Outlet:
(See Appendix B for flow data)

1. Tributaries -

Name	Drainage area (km^2)	Mean Flow (m^3/sec)
C-1 Ophir Creek	16.8	0.13
D-1 Franktown Creek	39.6	0.24
G-1 Winters Creek	4.7	0.02
Minor tributaries and immediate drainage -	137.2	0.48
Total	198.3	0.87
2. Outlet - A-1 Steamboat Creek	215.0	0.14

C. Precipitation:

1. Year of sampling: 30.2 cm.
2. Mean annual: 29.2 cm.

III. LAKE WATER QUALITY SUMMARY

Washoe Lake was sampled three times during the open-water season of 1975 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from three stations on the lake and from one or more depths at each station (see map, page v). During each visit, depth-integrated samples were collected from each station for chlorophyll a analysis and phytoplankton identification and enumeration. During the first and last visits, 18.9-liter depth-integrated samples were composited for algal assays. Maximum depths sampled were the surface at Station 01, 2.1 meters at Station 02, and 1.5 meters at Station 03. For a more detailed explanation of NES methods, see NES Working Paper No. 175.

The results obtained are presented in full in Appendix C and are summarized in III-A for waters at the surface and at the maximum depth for each site. Results of the phytoplankton counts and chlorophyll a determinations are included in III-B. Results of the limiting nutrient study are presented in III-C.

SHOE LAKE
STORET CODE 3208

PHYSICAL AND CHEMICAL CHARACTERISTICS

PARAMETER		(3/17/75) S*** = 3				(6/27/75) S*** = 3				(11/10/75) S*** = 3			
	N*	RANGE	MEDIAN	MAX DEPTH RANGE (METERS)		N*	RANGE	MEDIAN	MAX DEPTH RANGE (METERS)		N*	RANGE	MEDIAN	MAX DEPTH RANGE (METERS)	
TEMPERATURE (DEG CENT)															
0.-1.5 M DEPTH	5	2.6- 3.5	3.3	0.0-	1.5	4	13.7- 14.6	14.3	0.0-	1.5	3	6.4- 8.8	8.7	0.0-	0.0
MAX DEPTH**	3	2.6- 3.4	3.3	0.0-	1.5	3	13.7- 14.6	14.2	0.0-	2.1	3	6.4- 8.8	8.7	0.0-	0.0
DISSOLVED OXYGEN (MG/L)															
0.-1.5 M DEPTH	5	10.4- 10.6	10.4	0.0-	1.5	4	7.8- 8.2	8.2	0.0-	1.5	3	8.5- 9.2	9.2	0.0-	0.0
MAX DEPTH**	3	10.4- 10.6	10.6	0.0-	1.5	3	8.0- 8.2	8.2	0.0-	2.1	3	8.5- 9.2	9.2	0.0-	0.0
CONDUCTIVITY (UMHOS)															
0.-1.5 M DEPTH	5	498.- 584.	564.	0.0-	1.5	4	410.- 445.	435.	0.0-	1.5	3	368.- 461.	429.	0.0-	0.0
MAX DEPTH**	3	498.- 579.	564.	0.0-	1.5	3	410.- 440.	430.	0.0-	2.1	3	368.- 461.	429.	0.0-	0.0
PH (STANDARD UNITS)															
0.-1.5 M DEPTH	5	8.7- 8.8	8.8	0.0-	1.5	4	8.6- 8.8	8.8	0.0-	1.5	3	8.6- 9.8	8.6	0.0-	0.0
MAX DEPTH**	3	8.7- 8.8	8.7	0.0-	1.5	3	8.6- 8.8	8.8	0.0-	2.1	3	8.6- 9.8	8.6	0.0-	0.0
TOTAL ALKALINITY (MG/L)															
0.-1.5 M DEPTH	5	284.- 382.	330.	0.0-	1.5	0	***** *****	*****	*****	*****	3	358.- 392.	372.	0.0-	0.0
MAX DEPTH**	3	284.- 360.	314.	0.0-	1.5	0	***** *****	*****	*****	*****	3	358.- 392.	372.	0.0-	0.0
TOTAL P (MG/L)															
0.-1.5 M DEPTH	5	0.376-0.664	0.403	0.0-	1.5	2	0.240-0.260	0.250	0.0-	0.0	3	0.652-0.702	0.654	0.0-	0.0
MAX DEPTH**	3	0.395-0.664	0.403	0.0-	1.5	2	0.240-0.260	0.250	0.0-	2.1	3	0.652-0.702	0.654	0.0-	0.0
DISSOLVED ORTHO P (MG/L)															
0.-1.5 M DEPTH	5	0.251-0.299	0.270	0.0-	1.5	2	0.240-0.260	0.250	0.0-	0.0	3	0.250-0.290	0.288	0.0-	0.0
MAX DEPTH**	3	0.251-0.299	0.290	0.0-	1.5	2	0.240-0.260	0.250	0.0-	2.1	3	0.250-0.290	0.288	0.0-	0.0
NO2+NO3 (MG/L)															
0.-1.5 M DEPTH	5	0.040-0.080	0.080	0.0-	1.5	2	0.085-0.120	0.102	0.0-	0.0	3	0.020-0.040	0.040	0.0-	0.0
MAX DEPTH**	3	0.040-0.080	0.080	0.0-	1.5	2	0.085-0.115	0.100	0.0-	2.1	3	0.020-0.040	0.040	0.0-	0.0
AMMONIA (MG/L)															
0.-1.5 M DEPTH	5	0.040-0.050	0.050	0.0-	1.5	2	0.065-0.190	0.127	0.0-	0.0	3	0.020-0.400	0.020	0.0-	0.0
MAX DEPTH**	3	0.050-0.050	0.050	0.0-	1.5	2	0.175-0.190	0.182	0.0-	2.1	3	0.020-0.400	0.020	0.0-	0.0
KJELDAHL N (MG/L)															
0.-1.5 M DEPTH	5	1.000-1.400	1.100	0.0-	1.5	2	1.150-1.500	1.325	0.0-	0.0	3	1.300-1.600	1.400	0.0-	0.0
MAX DEPTH**	3	1.000-1.400	1.100	0.0-	1.5	2	1.500-1.800	1.650	0.0-	2.1	3	1.300-1.600	1.400	0.0-	0.0
SECCHI DISC (METERS)															
	3	0.1- 0.2	0.2			3	0.1- 0.3	0.2			3	0.1- 0.1	0.1		

* N = NO. OF SAMPLES
** MAXIMUM DEPTH SAMPLED AT EACH SITE
*** S = NO. OF SITES SAMPLED ON THIS DATE

B. Biological Characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera	Algal Units Per ml
03/17/75	1. Melosira	671
	2. Chroomonas?	79
	3. Cryptomonas	79
	4. Rhopalodia	79
	Other genera	---
	Total	908
06/27/75	1. Melosira	859
	2. Cryptomonas	136
	3. Euglena	136
	4. Rhopalodia	136
	5. Fragilaria	90
	Other genera	315
	Total	1,672
11/11/75	1. Melosira	1,111
	2. Epithemia	115
	3. Fragilaria	115
	4. Stauroneis	77
	5. Surirella	38
	Other genera	229
	Total	1,685

2. Chlorophyll *a* -

Sampling Date	Station Number	Chlorophyll *a* (µg/l)
03/17/75	01	20.7
	02	13.0
	03	12.8
06/27/75	01	6.3
	02	12.9
	03	4.7
11/10/75	01	13.4
	02	11.7
	03	9.2

C. Limiting Nutrient Study:

1. Autoclaved, filtered, and nutrient spiked - 03/17/75

Spike (mg/l)	Ortho P Conc. (mg/l)	Inorganic N Conc. (mg/l)	Maximum Yield (mg/l-dry wt.)
Control	0.250	0.064	4.4
0.05 P	0.300	0.064	3.9
0.05 P + 1.0 N	0.300	1.064	33.0
1.00 N	0.250	1.064	30.8

2. Discussion -

The control yields of the assay alga, Selenastrum capricornutum*, indicate that the potential for primary productivity in Washoe Lake was high on the March sampling date (03/17/75). In this assay, the increased growth of the test alga over the control yield in response to the addition of nitrogen, as well as the lack of response to the addition of phosphorus alone, indicate nitrogen limitation.

The November algal assay results are not considered representative of conditions present in the lake at the time of sample collection due to significant changes in nutrient concentrations in the samples during shipment from the field to the laboratory.

The mean inorganic nitrogen to orthophosphorus ratios (N/P) in the lake data were less than 2/1 on all three sampling occasions suggesting primary limitation by nitrogen (a mean N/P ratio of 14/1 or greater generally reflects phosphorus limitation).

*For further information regarding the algal assay test procedure and selection of test organisms, see U.S. EPA (1971).

IV. NUTRIENT LOADINGS
(See Appendix D for data)

For the determination of nutrient loadings, the Nevada National Guard collected monthly near-surface grab samples from each of the tributary sites indicated on the map (page v), except for the high runoff months of April, May, and June when two samples were collected. Sampling was begun in November 1974, and was completed in October 1975.

Through an interagency agreement, stream flow estimates for the year of sampling and a "normalized" or average year were provided by the Nevada District Office of the USGS for the tributary sites nearest the lake.

In this report, nutrient loads for sampled tributaries were determined by using a modification of a USGS computer program for calculating stream loadings. Nutrient loads indicated for tributaries are those measured minus known point source loads, if any.

Nutrient loadings for unsampled "minor tributaries and immediate drainage" ("ZZ" of USGS) were estimated by using the mean annual nutrient loads, in Ophir Creek, Franktown Creek, and Winters Creek, at Stations C-1, D-1, and G-1 and multiplying the means by the ZZ area in km^2.

A. Waste Sources:

1. Known municipal - None
2. Known industrial - None

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

Source	kg P/yr	% of total
a. Tributaries (nonpoint load) -		
C-1 Ophir Creek	130	7.5
D-1 Franktown Creek	335	19.3
E-1 Winters Creek	20	1.2
b. Minor tributaries and immediate drainage (nonpoint load) -	960	55.3
c. Known municipal STP's - None		
d. Septic tanks - None known		
e. Known industrial - None		
f. Direct precipitation* -	290	16.7
Total	1,735	100.0%
2. Outputs - A-1 Steamboat Creek	1,770	
3. Net annual P export** -	35	

*Estimated (See NES Working Paper No. 175)
**Export probably due to unknown sources and/or sampling error.

C. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

Source	kg N/yr	% of total
a. Tributaries (nonpoint load) -		
C-1 Ophir Creek	1,925	5.5
D-1 Franktown Creek	2,630	7.6
G-1 Winters Creek	370	1.1
b. Minor tributaries and immediate drainage (nonpoint load) -	11,935	34.3
c. Known municipal STP's - None		
d. Septic tanks - None known		
e. Known industrial - None		
f. Direct precipitation	17,910	51.1
Total	34,770	100.0%

2. Outputs - A-1 Unnamed Creek 8,875

3. Net annual N accumulation - 25,895

*Estimated (See NES Working Paper No. 175).

D. Mean Annual Nonpoint Nutrient Export by Subdrainage Area:

Tributary	kg P/km^2/yr	kg N/km^2/yr
Ophir Creek	8	115
Franktown Creek	8	66
Winters Creek	4	79

E. Mean Nutrient Concentrations in Ungaged Streams:

Tributary	Mean Total P (mg/l)	Mean Total N (mg/l)
*1-E Galena Creek	0.029	0.376
*1-F Jones Creek	0.024	0.497

*Special interest streams outside the Washoe Lake drainage basin.

F. Yearly Loadings:

In the following table, the existing phosphorus annual loading is compared to the relationship proposed by Vollenweider (1975). Essentially, his "eutrophic" loading is that at which the receiving waters would become eutrophic or remain eutrophic; his "oligotrophic" loading is that which would result in the receiving water remaining oligotrophic or becoming oligotrophic if morphometry permitted. A "mesotrophic" loading would be considered one between "eutrophic" and "oligotrophic".

Note that Vollenweider's model may not apply to lakes with short hydraulic retention times or in which light penetration is severely restricted by high concentrations of suspended solids in the surface waters.

	Total Yearly Phosphorus Loading ($g/m^2/yr$)
Estimated loading for Washoe Lake	0.10
Vollenweider's "eutrophic" loading	0.10
Vollenweider's "oligotrophic" loading	0.05

V. LITERATURE REVIEWED

Luchetti, F. 1977. Personal communication (septic tanks). Nevada Environmental Protection Service. Carson City, Nevada.

U.S. Environmental Protection Agency. 1971. Algal Assay Procedure Bottle Test. National Eutrophication Research Program, Corvallis, Oregon.

U.S. Environmental Protection Agency. 1975. National Eutrophication Survey Methods 1973-1976. Working Paper No. 175. National Environmental Research Center, Las Vegas, Nevada, and Pacific Northwest Environmental Research Laboratory, Corvallis, Oregon.

Vollenweider, R. A. 1975. Input-Output Models With Special Reference to the Phosphorus Loading Concept in Limnology. Schweiz. Z. Hydrol. 37:53-84.

Williams, James B., Jr. 1974. Personal communication (lake morphometry). Department of Human Resources, Carson City, Nevada.

VI. APPENDICES

APPENDIX A

CONVERSION FACTORS

CONVERSION FACTORS

Hectares x 2.471 = acres

Kilometers x 0.6214 = miles

Meters x 3.281 = feet

Cubic meters x 8.107×10^{-4} = acre/feet

Square kilometers x 0.3861 = square miles

Cubic meters/sec x 35.315 = cubic feet/sec

Centimeters x 0.3937 = inches

Kilograms x 2.205 = pounds

Kilograms/square kilometer x 5.711 = lbs/square mile

APPENDIX B

TRIBUTARY FLOW DATA

TRIBUTARY FLOW INFORMATION FOR NEVADA 1/21/77

LAKE CODE 3208 WASHOE LAKE

TOTAL DRAINAGE AREA OF LAKE(SQ KM) 215.0

TRIBUTARY	SUB-DRAINAGE AREA(SQ KM)	NORMALIZED FLOWS(CMS) JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
3208A1	215.0	0.003	0.008	0.020	0.201	0.176	0.269	0.340	0.340	0.235	0.102	0.003	0.003	0.142
3208C1	16.8	0.065	0.062	0.062	0.113	0.283	0.368	0.227	0.130	0.091	0.082	0.062	0.057	0.134
3208D1	39.6	0.11	0.11	0.11	0.20	0.54	0.68	0.40	0.23	0.17	0.14	0.11	0.11	0.24
3208G1	4.7	0.011	0.008	0.008	0.017	0.045	0.054	0.034	0.020	0.014	0.011	0.008	0.008	0.020
3208Z7	153.8	0.23	0.23	0.23	0.40	1.05	1.33	0.79	0.45	0.31	0.31	0.23	0.20	0.48

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 215.0
SUM OF SUB-DRAINAGE AREAS = 215.0
TOTAL FLOW IN = 10.51
TOTAL FLOW OUT = 1.70

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
3208A1	11	74	0.020	10	0.020				
	12	74	0.014	7	0.017				
	1	75	0.008	11	0.008				
	2	75	0.006	9	0.006				
	3	75	0.006	15	0.003				
	4	75	0.025	13	0.023	26	0.028		
	5	75	0.051	11	0.042	31	0.085		
	6	75	0.099	21	0.099	28	0.085		
	7	75	0.142						
	8	75	0.453	9	0.425				
	9	75	0.425	14	0.481				
	10	75	0.368	12	0.425				
3208C1	11	74	0.002	10	0.002				
	12	74	0.003	7	0.003				
	1	75	0.003	11	0.003				
	2	75	0.003	9	0.002				
	3	75	0.004	15	0.004				
	4	75	0.004	13	0.003	26	0.006		
	5	75	0.028	11	0.014	31	0.142		
	6	75	0.198	21	0.142	28	0.099		
	7	75	0.028						
	8	75	0.006	9	0.006				
	9	75	0.006	14	0.006				
	10	75	0.003	12	0.003				

TRIBUTARY FLOW INFORMATION FOR NEVADA 1/21/77

LAKE CODE 3208 WASHOE LAKE

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
3208D1	11	74	0.099	10	0.079				
	12	74	0.170	7	0.142				
	1	75	0.198	11	0.227				
	2	75	0.170	9	0.170				
	3	75	0.227	15	0.227				
	4	75	0.212	13	0.198	26	0.227		
	5	75	0.311	11	0.255	31	0.396		
	6	75	0.255	21	0.170	28	0.142		
	7	75	0.028						
	8	75	0.006	9	0.006				
	9	75	0.011	14	0.011				
	10	75	0.042	12	0.042				
3208G1	11	74	0.011	10	0.011				
	12	74	0.014	7	0.014				
	1	75	0.011	11	0.011				
	2	75	0.011	9	0.011				
	3	75	0.014	15	0.011				
	4	75	0.011	12	0.011	26	0.014		
	5	75	0.014	11	0.014	31	0.014		
	6	75	0.006	21	0.006	28	0.003		
	7	75	0.042						
	8	75	0.008	9	0.008				
	9	75	0.006	14	0.006				
	10	75	0.006	12	0.006				

APPENDIX C

PHYSICAL AND CHEMICAL DATA

STORET RETRIEVAL DATE 77/01/25
WATER AUTHORIZATION SURVEY
LAS-LAS VEGAS

320401
36 17 13.0 114 48 13.0 3
MASHOE LAKE
32031 NEVADA
15015

/TYPA/AMMNT/LAKE

ITEMBIES 04001002
0003 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
75/03/17	15 10	0000	2.6	10.6	4	498	8.70	284	0.050	1.400	0.040	0.251
75/06/27	14 30	0000	14.5	8.2	4	410	8.60		0.190	1.560	0.085	0.240
75/11/10	08 45	0000	6.4	8.5	3	368	9.80	158	0.400	1.600	0.030K	0.250

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
75/03/17	15 10	0000	0.664	20.7	
75/06/27	14 30	0000	0.240	4.3	
75/11/10	08 45	0000	0.654	13.4	

K VALUE KNOWN TO BE LESS
THAN INDICATED

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STORET RETRIEVAL DATE 77/01/28
*ETL FUTUREMICATI
*PAR=LAS VEGAS

/TYPE/AMBNT/LAKE

340402
34 15 00.0 114 47 27.0 3
*ASHUE LAKE
32031 NEVADA

150141

LITHOLOGIC 04001002
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
75/03/17	15 45	0000	3.5	10.4	8	584	8.75	382	0.040	1.100	0.040	0.270
	15 45	0005	3.4	10.4		579	8.70	314	0.050	1.100	0.040	0.299
75/06/27	14 10	0000	14.2	7.8	10	440	8.80		0.065	1.150	0.120	0.260
	14 10	0007	14.2	8.0		440	8.80		0.175	1.400	0.115	0.260
75/11/10	09 00	0000	8.7	9.2	4	429	8.60	372	0.020K	1.400	0.040	0.288

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHL-PHYL A UG/L	00031 INCDT LT PENNING PERCENT
75/03/17	15 45	0000	0.475	13.0	
	15 45	0005	0.403		
75/06/27	14 10	0000	0.260	12.9	
	14 10	0007	0.260		
75/11/10	09 00	0000	0.652	11.7	

K VALUE KNOWN TO BE LESS
THAN INDICATED

START RETRIEVAL DATE 77/01/26
APL HYDROMETEOROLOGICAL SURVEY
LAS VEGAS

376-03
36 14 44.0 114 47 30.0 3
LAKE MEAD
32031 NEVADA
1 0191

STORAGE/DISCHARGE

11 PARAMS 04001000
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00410 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
75/03/17	16 15	0000	8.3	10.4	7	561	8.80	330	0.040	1.100	0.070	0.264
	16 15	0005	8.3	10.6		566	8.80	360	0.050	1.000	0.080	0.280
75/06/27	13 50	0000	14.5	8.2	6	445	8.40					
	13 50	0005	13.7	8.2		430	8.50					
75/11/10	09 10	0000	8.4	9.2	3	481	8.65	342	0.020K	1.300	0.060	0.240

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00041 INCDT LT REMNING PERCENT
75/03/17	16 15	0000	0.376	12.-	
	16 15	0005	0.395		
75/06/27	13 50	0000		6.7	
75/11/10	09 10	0000	0.702	9.2	

K VALUE KNOWN TO BE LESS THAN INDICATED

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APPENDIX D

TRIBUTARY AND WASTEWATER TREATMENT PLANT DATA

...AL HYDROLOGIC SURVEY
...DA LAS VEGAS

...TER-QUALITY STATION

320441
39 19 45.0 119 47 05.0 4
Steamboat Creek
32 7.5 WASHOE CITY
07 WASHOE LAKE 19019
HWY 50 US 97 395 .5 MI NE OF WASHOE CITY
11 SAMPLES 04001000
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2+NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/11/10	10 30		0.004	2.500	0.350	0.270	0.440
74/12/07	09 50		0.045	2.300	0.050	0.195	0.300
75/01/11	11 30		0.040	0.500	0.082	0.194	0.270
75/02/09	09 15		0.025	0.800	0.065	0.170	0.300
75/03/15	09 55		0.050	1.100	0.035		0.290
75/04/17	13 00		0.005	0.950	0.030	0.180	0.260
75/05/26			0.005	1.050	0.103	0.185	0.280
75/06/11			0.015	1.050	0.200	0.200	0.350
75/07/31	10 35		0.035	1.250	0.050	0.200	0.270
75/08/21	10 00		0.050	1.250	0.050	0.195	0.310
75/09/24	11 30		0.030	1.100	0.025	0.190	0.310
75/08/09			0.030	2.500	0.035	0.330	0.400
75/09/14			0.035	1.400	0.045	0.450	0.460
75/10/12			0.100	2.400	0.070	0.375	0.460

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]
34 17 23.0 116 46 15.0 3
OPRIM CREEK
[illegible] 2.5 KASHUK CITY
[illegible]KASHUK LAKE 1-0191
[illegible] 34 05 MT 39.5 2.5 M SW OF KASHUK CITY
[illegible]ELES 04001004
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	NITROGEN NO3-NO2 TOTAL MG/L	PHOS-TOT IN BOT MATER MG/L	NITROGEN AMMONIA TOTAL MG/L	PHOSPHATE ORTHO MG/L P	PHOS-TOT MG/L P
74/11/13	11 35		0.010	0.200	0.030	0.020	0.030
74/12/17	11 15		0.004	0.100K	0.030	0.010	0.020
75/01/13	12 45		0.024	0.400	0.010	0.012	0.030
75/03/15	11 15		0.020	0.450	0.070		0.070
75/04/13	09 00		0.005	0.200	0.007	0.012	0.020
75/04/24			0.005	0.300	0.040	0.010	0.010
75/05/11			0.010	0.800	0.035	0.010	0.040
75/05/31	12 00		0.050	0.100	0.015	0.010	
75/06/21	11 00		0.010	0.150	0.015	0.010	0.020
75/06/24	14 00		0.005	0.100	0.0025	0.010	0.040
75/08/03			0.010	0.350	0.035	0.017	0.030
75/09/14			0.005	0.300	0.160	0.015	0.050
75/10/12			0.005	0.200	0.030	0.015	0.040

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K VALUE KNOWN TO BE LESS THAN INDICATED

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[illegible]
[illegible]
[illegible]

DATE FROM TO	TIME	DEPTH OF SAMPLE FEET	[illegible] DISSOLVED MG/L	[illegible] TOT KJEL N MG/L	[illegible] NITRO- TOTAL MG/L	[illegible] DISSOLVED NITRO MG/L P	[illegible] P-PO4-TOT MG/L P
74/11/18	10 55		0.018	0.700	0.015	0.005K	0.020
74/12/07	10 30		0.056	0.700	0.015	0.005K	0.010K
75/01/11	12 00		0.056	0.100	0.012	0.005K	0.030
75/02/04	10 05		0.050	0.150	0.025	0.005	0.030
75/03/15	10 30		0.024	0.250	0.007	0.007	0.040
75/04/12	12 00		0.014	1.200	0.030	0.007	0.030
75/04/28			0.010	0.500	0.020	0.010	0.020
75/05/11			0.050	0.400	0.095	0.016	0.045
75/05/31	11 00		0.050	0.500	0.015	0.010	
75/06/21	10 30		0.050	0.200	0.010	0.005K	0.010
75/06/28	12 00		0.045	0.300	0.005	0.005	0.030
75/08/05			0.150	0.400	0.010	0.005	0.040
75/09/16			0.070	0.500	0.050	0.010	0.050
75/11/12			0.075	0.200	0.005K	0.005K	0.010

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K VALUE KNOWN TO BE LESS THAN INDICATED

APPENDIX E

PARAMETRIC RANKINGS OF LAKES SAMPLED BY NES IN 1975

STATE OF NEVADA

Mean or median values for six of the key parameters evaluated in establishing the trophic conditions of Nevada lakes sampled are presented to allow direct comparison of the ranking, by parameter, of each lake relative to the others. Median total phosphorus, median inorganic nitrogen and median dissolved orthophosphorus levels are expressed in mg/l. Chlorophyll a values are expressed in µg/l. To maintain consistent rank order with the preceding parameters, the mean Secchi disc depth, in inches, is subtracted from 500. Similarly, minimum dissolved oxygen values are subtracted from 15 to create table entries.

LAKE DATA TO BE USED IN RANKINGS

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	EOO-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P
3201	LAKE MEAD	0.016	0.340	266.565	3.111	11.400	0.005
3202	LAHONTAN RESERVOIR	0.198	0.350	472.033	4.608	10.400	0.148
3204	RYE PATCH RESERVOIR	0.094	0.050	467.750	4.938	10.000	0.039
3205	LAKE TAHOE	0.005	0.040	-3.269	0.571	10.200	0.003
3206	TOPAZ RESERVOIR	0.057	0.165	376.000	7.517	14.600	0.041
3207	UPPER PAHRANGAT LAKE	0.173	0.125	470.000	---	8.600	0.026
3208	WASHOE LAKE	0.403	0.130	494.555	11.633	7.200	0.268
3209	WILD HORSE RESERVOIR	0.114	0.320	489.400	75.530	14.600	0.065
3210	WILSON RESERVOIR	0.049	0.120	197.333	10.033	11.400	0.016
3211	WALKER LAKE	0.602	0.080	405.333	3.422	15.000	0.574

PERCENT OF LAKES WITH HIGHER VALUES (NUMBER OF LAKES WITH HIGHER VALUES)

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P
3201	LAKE MEAD	89 (8)	11 (1)	78 (7)	88 (7)	39 (3)	89 (8)
3202	LAHONTAN RESERVOIR	22 (2)	0 (0)	22 (2)	63 (5)	56 (5)	22 (2)
3204	RYE PATCH RESERVOIR	56 (5)	89 (8)	44 (4)	50 (4)	78 (7)	56 (5)
3205	LAKE TAHOE	100 (9)	100 (9)	100 (9)	100 (8)	67 (6)	100 (9)
3206	TOPAZ RESERVOIR	67 (6)	33 (3)	67 (6)	38 (3)	17 (1)	44 (4)
3207	UPPER PAHRANAGAT LAKE	33 (3)	56 (5)	33 (3)	---	89 (8)	67 (6)
3208	WASHOE LAKE	11 (1)	44 (4)	0 (0)	13 (1)	100 (9)	11 (1)
3209	WILD HORSE RESERVOIR	44 (4)	22 (2)	11 (1)	0 (0)	17 (1)	33 (3)
3210	WILSON RESERVOIR	78 (7)	67 (6)	89 (8)	25 (2)	39 (3)	78 (7)
3211	WALKER LAKE	0 (0)	78 (7)	56 (5)	75 (6)	0 (0)	0 (0)